THE METAL INDUSTRY

WITH WHICH IS INCORPORATED THE ALUMINUM WORLD.

A TRADE JOURNAL RELATING TO THE NON-FERROUS METALS AND ALLOYS.

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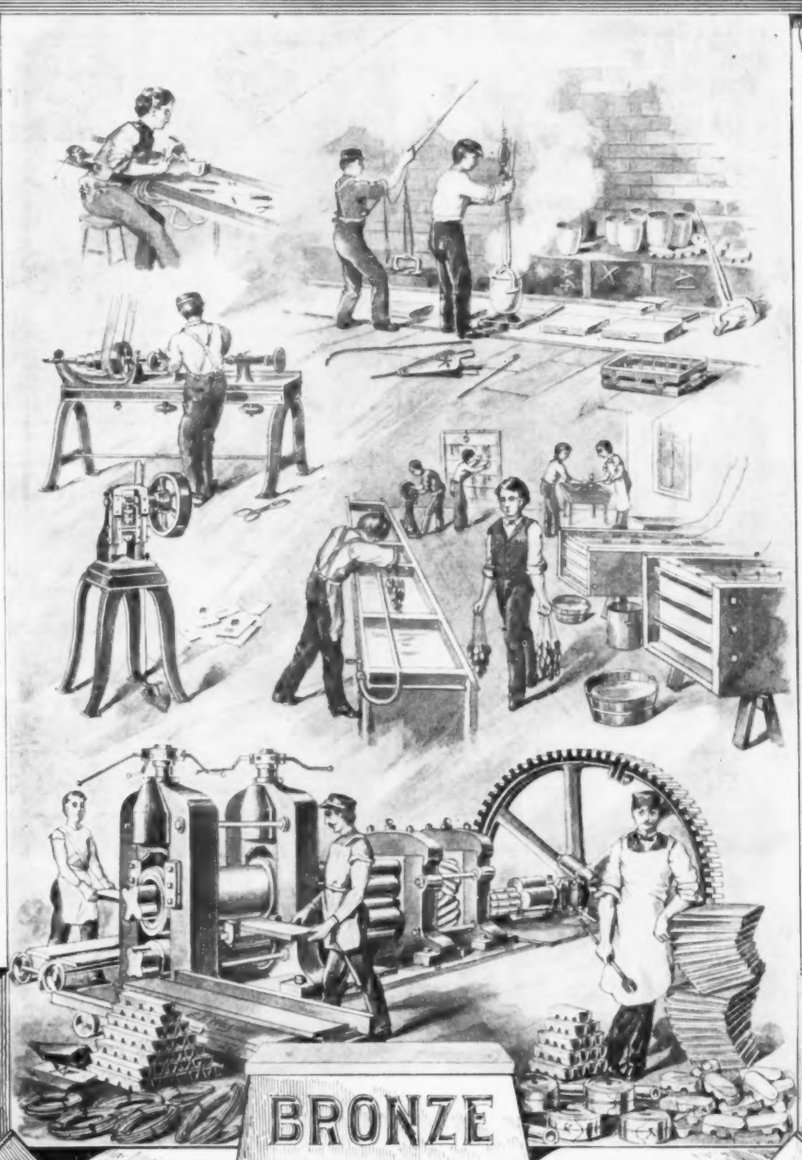

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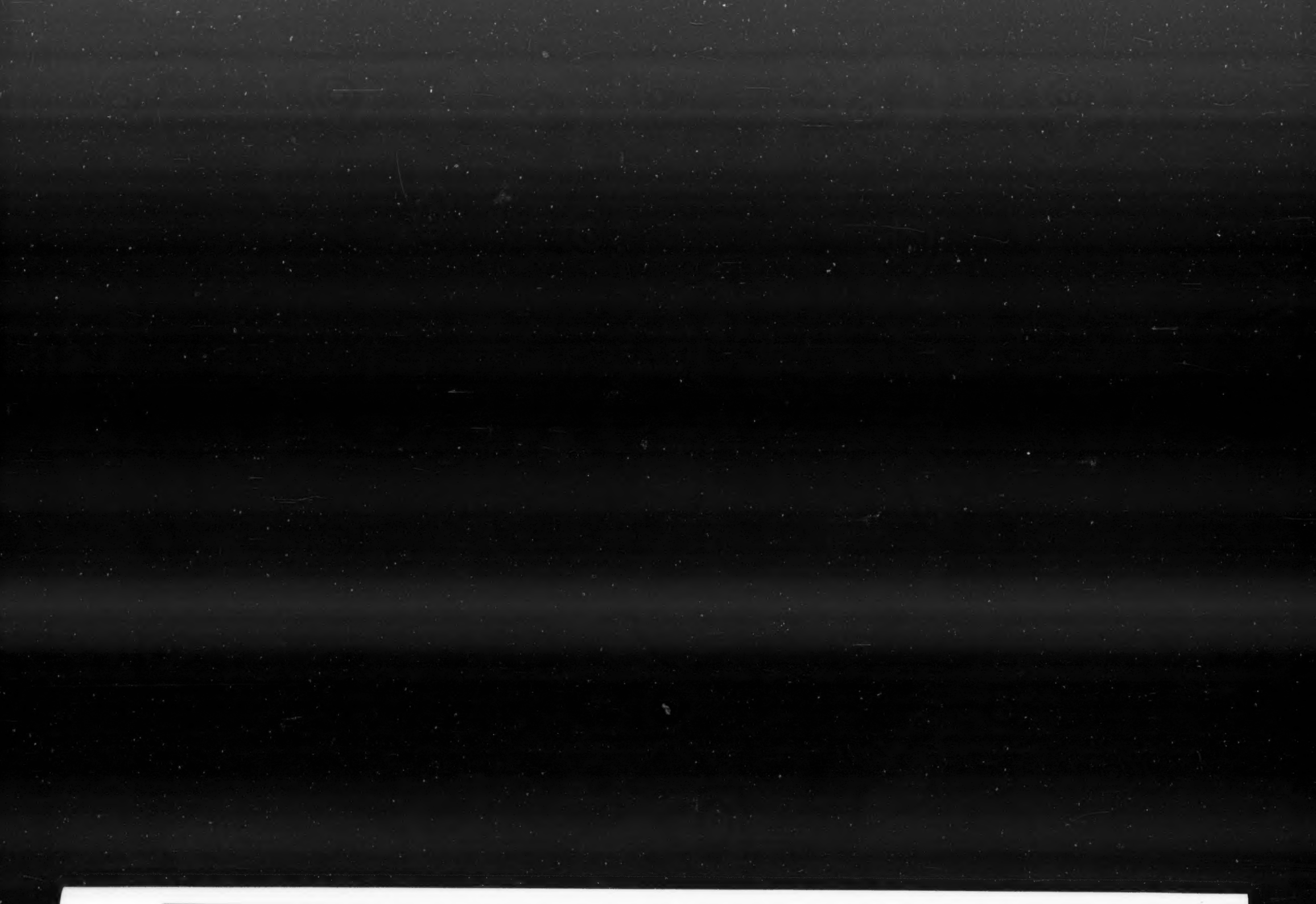

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An erroneous opinion appears to exist in certain quarters that the former ALUMINUM WORLD and the present METAL INDUSTRY is under the control of metal producers. No aluminum company ever owned one dollar of interest in THE ALUMINUM WORLD, nor does any brass, copper or other metal company own a share of stock in THE METAL INDUSTRY PUBLISHING COMPANY. Our journal is entirely independent, and our intention is to speak the truth, whatever it may be.

PROPOSED CHANGE IN THE FORM OF COPPER INGOTS.

The subject of change in the present form of copper ingots is now being agitated by some of the copper-producing companies in order to facilitate the use of the various recent appliances for casting them. The usual form of copper ingot, weighing from twelve to twenty pounds each, and provided with three so-called "heels," has remained unchanged from the earliest period of the copper industry in the United States, and while such ingots possess an individuality peculiarly their own, the shape renders it somewhat difficult to cast them successfully in the refining plants using modern appliances for the elimination of the "ladler" with his hand ladle. The "heels" on a copper ingot were originally introduced for the purpose of facilitating the operation of cutting up by means of a cold chisel and hand sledge, but now that most of the mills are provided with alligator shears and the fact that little cut copper is used, compared with formerly, there is no reason why the form of the copper ingot should not be materially changed without inconveniencing the consumer to any extent.

This agitation in regard to changing the form of the ingots is the result of the attempts now being made to

supplant the so-called "ladler" by mechanical appliances. The operation, as conducted by the "ladler," is simply one of dipping the copper out of the furnace by means of iron ladles and pouring into the ingot-mold. This necessitates a large number of men and a constant expense for ladles, as the life of these appliances is short. The methods now in use in some plants and those proposed in others is to either run the copper after it has been brought up to "pitch" into a "bull" ladle and from this pour into the molds by means of crane appliances, or the employment of tilting furnaces of their equal. It will be readily seen that the casting of small masses by such means is much more difficult than by hand. The large expense of the ladling gang and the cost of the ladles have stimulated the copper refineries in this direction. The question of change in the shape of ingots and the reasons therefor was proposed some time ago,* but we doubt very much whether some of the radical changes proposed by certain copper producers will result in anything but disfavor. The casting of copper in long rectangular bars to be cut up by the consumer has been mentioned; others suggest the connecting of the usual form of copper ingot by means of webs to be afterwards severed.

As far as brass manufacturers are concerned and others who melt their copper in crucibles, the most satisfactory form of copper ingot is one which possesses no "heels," but is a simple rectangular form. It may be somewhat longer than the usual copper ingot (12 inches is a good length) and a little wider and thicker (4 x 4 inches may be used). This shape and size renders the mass easily handled and gives a satisfactory weight, for the larger the mass of metal melted the better the resulting metal. In order to accomplish this in practice we suggest that the copper companies cast the copper in 4 x 4 billets, of length convenient for themselves, and then cut it in lengths of one foot. In order to have such a new condition of metal quickly accepted a slight concession in price will, perhaps, be necessary in order to cast aside the time-honored prejudice of the brass-caster against anything but the rose-red ingot with its level and wavy top.

*Remarks on the General Form of Ingots, by E. S. Sperry. Trans. Am. Inst. Mining Eng., Feb., 1898.

RADIUM.

If the reports already published about this metal are true, no more remarkable substance has ever been discovered. It is remarkable in the sense that its properties actually disprove certain theories already universally accepted as facts, and, granting that this is so, the very fundamental principle of physical science, viz., the law of conservation of energy, goes for naught. The careful scientist is cautious about accepting such antagonistic statements until proven beyond all doubt. We have in mind a similar condition of affairs, when Kruss in 1888 announced that nickel and cobalt were not elementary metals, but composed of two or more elements. The report was heralded from one end of the world to the other, as the beginning of the breaking up of the metals into other constituents, only to become proven a fallacy within a short time. We do not predict any such disaster for the exponents of radium, but are inclined to wait until more is known before even scouting any of its reported properties.

For years it has been known that certain metals existed in the sun which had never been detected in terrestrial substances. M. Curie, a French scientist, recently discovered one of these celestial elements in a mineral called pitchblende, and to which he gave the name of radium. This name was given to the metal because of its property of continually giving off heat and light. The report says that this evolution of heat and light continues without any diminution of weight, and that the metal, even after months, shows no alteration. This very fact of maintenance of original condition is the one which places the metal in such a remarkable position. Were it not for this absence of diminution of weight radium would, perhaps, rank with phosphorus, an element which possesses similar properties but constantly decreases in weight from actual combustion. With radium, however, heat and light are emitted without combustion taking place. The fact hitherto not disproven that "Various forms of energy may change into each other, but the sum total present in the universe always remains the same," now remains a subject of dubious existence. The actual heat given out by radium is sufficient, so the reports say, to melt its own weight of ice every hour, or to raise the mercury in a thermometer 2.7 degrees Fahrenheit.

It is not only the disproval of the law of conservation of energy which interests us, but the veritable approach of perpetual motion, a culmination long sought and invariably frustrated by nature. It is difficult for us to believe these things, and yet no less able scientist than Sir William Crookes has partially agreed that M. Curie is correct in the majority of his assertions.

The cost of a pound is said to be about $1,000,000, so that we have no alternative but to wait patiently for it to become cheaper. In spite of its cost, it is said that an Arctic explorer recently took a small bit on his journey for the purpose of giving light, and with good results.

Some Cincinnati capitalists believe that there is an excellent opportunity for the locating of a brass and copper rolling mill in that city and are now trying to establish a plant.

It is reported that the Standard Oil Company are endeavoring to get the pig tin industry under their control. This company are the largest consumers of tin plate in the world, hence their interest in the matter.

The firm of Aron Hirsch & Sons, of Halberstadt, Germany, estimate that of the world's consumption of copper in 1902 about 20,000 tons was of old metal. Of this 7,762 tons came from Germany and the balance principally from the United States and England.

The American Electrochemical Society held a very successful third general meeting at New York, from April 16 to 18, 1903. Over two hundred members were present and great interest was taken in the papers presented. Abstracts of the papers which relate to practical metallurgy will be published in THE METAL INDUSTRY.

ALLOYS

By Commander Warner B. Bayley, U. S. Navy.*

There has been a marked increase in the use of alloys during recent years. Particularly on board sea-going ships, where structural strength combined with non-corrosive qualities are essentials in the character of the machinery used, the increased use of alloys is very apparent. While it may be said in general of all structural material, that with the increased demand there has been a progressive improvement, this statement is particularly true of alloys. The improvement as regards the quality of alloys and the uniformity of manufacture may be attributed more to the improved methods of manipulation of the constituents rather than to the character of the metal or to the change in proportion of the component parts.

So much, in fact, depends on the expert supervision and care exercised in the foundry where the brass and copper billets are cast, that some of the mills hold the men employed in this department responsible for the quality of the output. Should the metal, when it is tested after being cast, fail to come up to the standard requirements, the entire cost of the material is charged to their pay account. For this purpose, each billet cast in the foundry bears the workman's number who is responsible for the casting, by which means subsequent failure of the metal can be traced back to the responsible party. This custom insures the greatest care on the part of the workmen in mixing the metals.

Very recently, some of the great brass and copper mills of the Naugatuck Valley have adopted the custom of making frequent analytical tests during the operations of mixing and casting each heat, the chemical laboratory being kept in constant operation for that purpose. The marked improvement in foundry methods, due to the greater care on the part of the workmen, has resulted in a partial solution, at least, of the well-known difficulty of obtaining uniform results, as to mechanical qualities, with a given alloy.

Other causes which have contributed in a great measure to the improvement in the quality of the alloys are the very carefully drawn specifications, and rigid system of inspection adopted by the U. S. Navy Department for all copper, brass and bronze material entering so largely into the construction of the modern ship and its accessories. It has been my experience that manufacturers were at first disposed to complain of Government specifications as being unnecessarily rigid and difficult to comply with. I hear very little of this now; and, in fact, some manufacturers claim that they are now in advance of Government specifications. In any event, it may be safely claimed that the quality of the material comprising the tin, zinc and copper alloys has greatly improved within a comparatively short time, due to improved methods in manipulation and manufacture. I have thought, therefore, that a brief description of some of the methods employed in the manufacture of two or three of the principal alloys may be of interest to the readers of the Journal.

Copper and Brass Tubing.—The various manufacturers of copper and brass tubing employ radically different methods of manufacture, each claiming superiority in some particular of their special method, but all aiming at the same result, that is, to produce a seamless brass or copper tube perfectly true as to form, and concentric, of equal thickness in all parts, free from all surface defects, and that will comply with the required specifications as to the chemical qualities and strength of material.

In one establishment the brass and copper billets are cast solid. It being important that the metal should cool quickly, the billets are cast in iron molds, and precautions are taken to have the molds very clean, and well dressed with lard oil and graphite. Great care is also taken to have the temperature of the molten metal just right, neither too hot nor too cold, and the distribution of the stream governed and prevented from sticking to the sides of the mold. The copper billets, except the very large sizes, are cast in open molds, and then rolled hot to the required diameter and length. No zinc is used in the copper billets, government specifications requiring 99.5 per cent. pure lake copper. The billet is then heated to a white heat (after being rough-turned to remove all surface imperfections), and in that state is passed through a set of three rolls. These rolls are set at an angle with each other and with the billet. The billet is hollowed at one end, and when it is introduced into the rolls a mandrel is centered in the hollow end. The motion of the rolls feeds the billet along, and at the same time forces it over the arbor or mandrel. After passing through this operation the billet has become a hollow cylinder. At the same time the peculiar motion of the rolls has given to the metal a decided twist of fiber. This twisting of the fiber, the manufacturers claim, adds to the strength of the finished tube and its powers to resist internal pressure. After this operation the hollow cylinders are passed to the draw benches, where they are drawn cold through dies to the proper size and gauge of tube. Seamless copper tubes are now drawn to commercial lengths (12 feet) as large as 12 inches in diameter and No. 0 B.W.G. (.340 inch) in thickness. The above process, known as the Mannesmann, from the name of the inventor, was first introduced into Germany about twelve years ago. At first no mandrel was used, the solid billet being forced between the diagonally-acting rolls so proportioned and adjusted as progressively to reduce the diameter of the billet to a prescribed extent, while imparting to it a prescribed number of rotations. By this operation the billet was ruptured along the line of its axis and thereby made to assume a tubular shape. Many improvements have, from time to time, been introduced by the inventor, resulting finally in the process first described. The Benedict & Burnham Mfg. Co., of Waterbury, Conn., are the only manufacturers that use this process.

By the usual process followed by the great mills of Connecticut and Massachusetts the billets are cast hollow, and, after being thoroughly cleaned in a bath of sulphuric acid, the billet or shell is forced over an expander, the object being to develop any imperfections or flaws in the casting before it is sent to the draw benches for the final drawing. In the operation of drawing the tube from the cast shell both care and skill are required in order not to strain the metal. Separate draw benches are used for the different sized tubes, and a dynamometer is used to measure the stress on the metal during the operation of drawing. By this means the metal is never strained beyond its safe tensile strength, and the danger of seams and cracks in the finished tube, which would possibly be invisible to surface inspection, thereby avoided.

At one of the largest brass and copper mills in Waterbury, Conn., instead of using a cast billet or shell, a sheet or disc of rolled metal is forced into the form of a cylinder by a punch and die. The subsequent drawing to a tube of given size is done in the usual manner. The advantage

*A paper read before the American Society of Naval Engineers.

of this method is that a larger tube can be made, a specialty of this company being copper boilers.

Brazed tubing is still made in large quantities. It is principally used now, however, for plumbing and gas fixtures. None is used on board the ships of our Service. Brazed copper steam pipes as large as eight inches in diameter, strengthened by serving with closely laid copper wire wound under tension, are now being used to some extent abroad, I am informed.

In the manufacture of brass pipe, iron pipe size, the Government specifications require 60 to 70 per cent. pure copper and from 30 to 40 per cent. pure zinc. Considerable trouble has been experienced by the use of an inferior quality of western spelter (zinc) containing as high as 0.6 per cent. of lead and 0.3 per cent. of iron. An average of not more than 0.35 per cent. lead for iron pipe size and 0.2 per cent. lead for condenser tube has been decided upon by the Bureau of Steam Engineering as a limit of this impurity. Some manufacturers strongly advocate putting in enough lead to insure 0.5 per cent. in the casting, instead of the 0.35 per cent., for iron pipe size, claiming that it will not impair the quality of the tube, while to reduce it 0.2 per cent. below that adds greatly to the cost of the material. It is my opinion, based upon many tests of this material, that for iron pipe size, when threading is to be done, 0.4 to 0.5 per cent. of lead, and for condenser tube ferrules as high as 0.6 per cent. of lead, would be advantageous, as the material would work much better and its physical qualities would not be reduced to an appreciable degree. I have seen experiments made with brass rod containing as high as 2 per cent. of lead, the only apparent effect being to reduce elongation slightly.

Naval Brass.—Experience with this material illustrates the truth of my remark as to the great improvement in the quality of alloys of very recent times, due to improved methods of manipulation. The results of sixty-six tests made by this office of naval brass give the following as an actual average:

Maximum strength per square inch, pounds...	61,895
Elastic limit per square inch, pounds.....	30,953
Reduction of area, per cent.....	32.2
Elongation in 8 inches, per cent.....	22.9
Elongation in 2 inches, per cent.....	29

As these tests were quite uniform as to results, together with the fact that this material can be forged at a white heat as readily as steel, shows that it possesses the qualities of good open-hearth steel, with the additional advantage of being non-corrosive. The above results are in excess of the requirements of the Navy Department for naval brass as given in the specifications of 1901. Department specifications for naval brass require that it shall be composed of from 61 to 63 per cent. pure copper, 1 to 1½ per cent. tin, and the remainder zinc. Round bars ¾ inch in diameter and less to possess not less than 58,000 pounds ultimate tensile strength. Round bars over ¾ inch diameter not less than 50,000 pounds ultimate tensile strength, with not less than 10 per cent. elongation. The improvement in the quality of this alloy is apparent from the above figures. The results shown in the above table of tests made by this office, covering a period of eighteen months, would indicate that, with proper care and precaution in working, a fairly uniform and reliable material can be produced, having physical qualities that recommend it to designing engineers for use on board ship, for specific purposes, above all other material. Naval brass rods are now produced as large as 5 and 6 inches in diameter, and in length as great as 12 feet.

The effect upon the physical properties of the alloy produced by the manipulation employed in reducing it to desired forms is very great, and is not well understood by designing engineers obliged to rely for information on the subject upon tests of such material as is furnished in the market. This is more particularly true of those alloys of copper with zinc and tin which are formed into the required shapes from the casting by the process of cold rolling or drawing. By this cold rolling or cold drawing process marked changes in the physical properties are produced, which, provided these operations are carried far enough, without the intervention of other processes (annealing), totally change the physical properties. The tensile strength and elastic limit are increased, and the percentage of elongation and contraction of area are reduced. The extent of these changes varies somewhat for given mixtures for the same amount of cold working. These changes, however, almost completely disappear when the piece is subjected to a temperature of about 80 per cent. of the melting point, corresponding, for most mixtures, to a red heat, and the physical properties become practically those of the original casting. As an illustration of the extent of these changes the following tests of a sample of naval brass, a bar of which was treated as described below, of an approximate composition of 63 per cent. copper, 36.15 per cent. zinc and .85 per cent. tin, are given in the table below.

A sample bar of the above mixture was reduced to 1.249 inches diameter and carefully annealed. Three pieces were cut from it: the first was left as annealed, the second was drawn through a die to 1.224 inches diameter, and the third similarly drawn through a die to 1.063 inches diameter, a reduction respectively of 3.7 per cent. and 27.3 per cent. in area. All three samples were tested, with the results given in the table.

Sample No.	Tensile strength per square inch.	Elongation in 4 inches.	Contraction of area.	Yield point.
1	54,300	49.0 per ct.	43 per ct.	23,700 lbs.
2	57,100	43.4 per ct.	41 per ct.	33,700 lbs.
3	81,080	4.9 per ct.	36 per ct.	76,700 lbs.

The properties of this material are such that it can be given a very high tensile strength and elastic limit by cold drawing, but should it subsequently be heated in the operation of forging, these high values will be reduced to the result as shown in sample No. 1. I am indebted for the above table of tests, with remarks, to Mr. W. R. Webster, Jr., General Manager of the Bridgeport Brass Co., Bridgeport, Conn.

CONDENSER TUBES.

For the past two years, with few exceptions, all condenser tubes made for the Navy have been of the composition Cu, 70; Zn, 29; Sn, 1 (Admiralty mixture), not tinned, and, in the light of present knowledge on the subject, it is perhaps the best adapted to the purpose of all the alloys.

Tubes made of the mixtures Cu, 85, and Ni, 15 (Benedict Nickel) have recently been fitted in the main condensers of one of our ships, but I believe as yet no reports have been received which will serve to base any positive opinion upon in regard to the merits of the composition for this special purpose.

Until quite recently, the composition Cu, 60 and Zn, 40 (Muntz metal), tinned all over, was used almost exclusively in the Navy. The battleship *Wisconsin* is fitted with Muntz metal tubes and, though only about two years commissioned, the tubes are giving out and will have to be renewed. Some experiments were recently made with this alloy, the results showing that the composition Cu, 60, and Zn, 40, is rapidly attacked by sea water. When a small percentage of iron, nickel or manganese, say .2 to .3 of 1 per cent. is present, the alloy resists the action of the sea water much better than when copper and zinc alone are used. It will be interesting to note the condition of the *Wisconsin's* tubes when removed—whether deterioration is due to disintegration, splitting or corrosion.

A writer on the subject recently attributed much of the trouble with condenser tubes in the Navy to the fact that the tubes are drawn too light, No. 18 B.W.G. being the standard thickness of tubes, claiming that the life of the metal was destroyed by drawing from No. 16 B.W.G. to No. 18 B.W.G., and giving this as a reason for the better showing in the merchant service. This has not been the experience of this office, however, in testing the strength of tubes of all gauges. Tubes as light as No. 18 and No. 20 B.W.G., provided they are slightly annealed after the final drawing, possess all the qualities of ultimate strength, elongation and elastic limit as the heavier tubes.

Many theories have been advanced for the rapid deterioration of condenser tubes, other than that due to the alloy, electrolysis being one, and it has been suggested that the condensers should be completely insulated from the hull of the ship and from all piping. Unfortunately for this argument, however, the trouble existed quite as much in the days of wooden hulls as it does now. It is believed also by many that our condensers are too small for the work required of them. The fact that the ratio of total cooling surface to total heating surface in the Navy is about 1 to 1.5, whereas in the merchant service it is as high as 1 to .5, is given to prove this. It is a mistake, however, to suppose that the merchant service is exempt from this trouble. I have been told by the tube makers that it exists in the merchant service, though perhaps to a less extent than in the Navy. It is certain, however, that much, if not all, depends on the alloy, as well as the character of the workmanship of the tube maker. I believe we are getting a better condenser tube in the service to-day than ever before—due, as I have before stated, to improved methods—and I hope to see a marked improvement in the life of the tube.

I believe, however, it would be worth while, as an experiment, to fit a condenser with tubes of the composition Cu, 85; Sn, 1 to 1½, and the balance pure zinc, or as pure as can be obtained in the market, the ratio of cooling to heating surface to be about 1 to .75, tubes to be ¾ inch diameter.

Extruded Metal.—By the process of extrusion, bars or rods of almost any particular cross section in brass or high tensile-strength bronze are produced, and so accurately that no machining is afterwards required. These special-shaped wrought rods, bars and angles are used in long lengths, or cut up into short sections, and supersede castings for many purposes.

The process consists of squeezing the heated metal through dies of almost any desired shape by hydraulic pressure (oftentimes as high as 60,000 pounds per square inch). The very high compression to which the semi-plastic material is thus subjected renders it perfectly homogeneous and free from possible casting defects. Its molecules are densely compressed, and the quality must necessarily be greatly improved. Extruded bars or rods consequently possess, in a very marked degree, those qualities which are essential for sound engineering work.

Various alloys may be used in this process, but not all of the alloys commonly rolled or cast. In addition to bars or rods of irregular cross section, all stock sizes of round, hexagon, square, rectangular, half-round, etc., are produced, suitable for forging into bolts or for all engineering purposes. Alloys used for this purpose are naval brass, Muntz metal, and other special bronzes suitable for forging. The alloys used for making angles, T bars and special shapes for marine work are approximately the same as naval brass, containing copper, tin and zinc in proper proportions to extrude into these shapes satisfactorily. All such alloys have high tensile strength and are particularly non-corrosive in their qualities. A recent test by this office of naval-brass extruded rods for bolt stock, to be used on the U. S. S. *Chattanooga,* resulted as follows:

Diameter	.875
Reduced diameter	.785
Reduction of area, per cent.	19.4
Elastic limit per square inch	41,600
Maximum strength per square inch	63,200
Elongation in 8 inches, per cent.	21

A test of an extruded angle of large size for the cruiser *Des Moines* resulted as follows:

Reduction of area, per cent.	20
Elastic limit per square inch	33,800
Maximum strength per sqare inch	80,500
Elongation in 8 inches, per cent.	18.1

The dimensions of the bars produced are limited by the weight of the billet adapted to the extrusion machine. Billets usually range in weight from 150 to 175 pounds, and rods are produced ranging in weight from ¼ of a pound per foot and about ⅜ inch in diameter to sections 10 to 12 ponds per foot and 4 to 5 inches in width. It will thus be understood that light sections may be had in long lengths, and heavy angles in lengths from 12 to 18 feet. The extrusion process of making rods for engineering work insures greater uniformity in the material than ever before possible, and for special purposes alloys may be produced having requisite tensile strength or elongation adapted for the work, even up to the strength of good quality steel, at the same time non-corrosive.

In addition to the extruded rods in common sizes and shapes, such as rounds, hexagons, squares etc., T angles, I beams and bulb angles of any description are manufactured for use in hull construction of battleships, torpedo boats and yachts. Many yachts and launches have already been made with the frames entirely of extruded bronze bulb angles in place of steel. The material has also entered into the construction of self-closing compartment doors for ships, ammunition chain rollers, stanchions, and in other places where reliability, strength, and non-corrosive qualities are required.

The hull of the new cup defender is of Tobin bronze, while the framing is of steel. As bulb angles and beams of sizes up to six-inch are made by the extrusion process, and as the metal possesses the strength and stiffness of mild steel, it would seem admirably adapted to this purpose.

The extrusion process, though new to this country, has been in use for some time in England and on the Continent. The Coe Brass Manufacturing Co., of Ansonia, Conn., are making this material in this country, and are now adding to their plant, for the purpose of manufacturing it on a more extensive scale.

Tobin Bronze.—There has been a marked increase in the use of this material on board ships of the Navy in very recent years for pump rods, bolts and nuts; and in cases where a stronger and more reliable material than it is possible to obtain with cast metal is required, Tobin bronze is extensively used. It is now made in round and hexagonal bars as large as six inches in diameter, and in commercial lengths. The following are about the average of a number of tests of this material, made by this office:

Diameter of sample, inches	1.25
Area, square inches	1.227
Reduced diameter, inches	.925
Reduced area, square inches	.672
Reduction of area, per cent.	45.2
Elastic limit, pounds	53,000
Elastic limit, per square inch, pounds	43,200
Maximum strength, pounds	75,000
Maximum strength, per square inch, pounds	61,200
Elongation in eight inches, per cent.	36.63
Elongation by inches	.34 .37 .23 .34 .70 .42 .32 .21

The Ansonia Brass & Copper Co., Ansonia, Conn., where this material is manufactured, have a very extensive plant, containing special machines for straightening and turning rods, so that piston rods up to six inches in diameter, and finished to size, are turned out.

The gross value of the brass and copper alloys produced in the State of Connecticut during the past year is upwards of sixty millions of dollars ($60,000,000), and, as a matter of comparison, the business generally has increased at the rate of 10 per cent. a year for the past decade. About 20,000 persons are employed in this industry in this State. One company alone in the Naugatuck Valley produced, approximately, fifteen million (15,000,000) pounds of copper tubing and brass rod during the past year.

In 1890 five firms engaged in the manufacture of copper and brass produced 5,000,000 pounds, and in 1900 eleven firms produced 29,500,000 pounds of rolled brass and copper.

THE STEEL INDUSTRY ADOPTS BRASS METHODS.

Contrary to the usual condition of affairs, a case has recently come to our notice in which the methods of the brass industry have been copied by certain steel mills. As a usual rule, the opposite is the case. In this instance a tube drawing device has been patented by Ralph S. Stiefel and Richard T. Brown, of Elwood City, Pa., and assigned to the Standard Seamless Tube Co., of Elwood City, Pa. (U. S. Pat. No. 718,671, Jan. 20, 1903). This device has been used for upwards of twenty-five years at least in the brass tube mills in the United States and how much longer is unknown at the present time. The device was illustrated in THE METAL INDUSTRY for March. The fact that seamless brass and copper tubing have been made for many years, while seamless steel tubing is a comparatively recent invention, explains this ludicrous condition of affairs. The inexperience of the Patent Office in the same direction is likewise noted.

COPPER-SHEATHED PASSENGER COACHES

The New York, New Haven & Hartford Railroad Co. are building 126 passenger coaches, all of which are to be sheathed with copper sheet after the process patented by Mr. Wm. P. Appleyard, their master car builder. In Fig. 1 we herewith show the first car ever sheathed in this manner. This car, No. 365, was put in service January 18, 1896, and is yet running in excellent condition. In fact there is no perceptible difference in the appearance from that when the car went into use. The cars sheathed with copper need no painting, and are proof against scratching. The copper used on the original cars was .018 in. thick, and was cold rolled enough to give a smooth surface, but not sufficient to harden it appreciably. In Fig. 2 is shown the method of sheathing the car. Strips of soft wood one-half an inch in thickness and one and three-quarters inches wide are tongued and grooved in the usual manner employed for sheathing cars with wood. Over this the copper is bent before the sheathing is placed on the car. No nails or screws are used, but the edge of the copper sheet overlapping that of the next in the tongue and groove serves to hold the metal in place. The copper is oxidized to a black color. The letters on the car are to be of four per cent. aluminum bronze, cast in sand, and fastened on with screws.

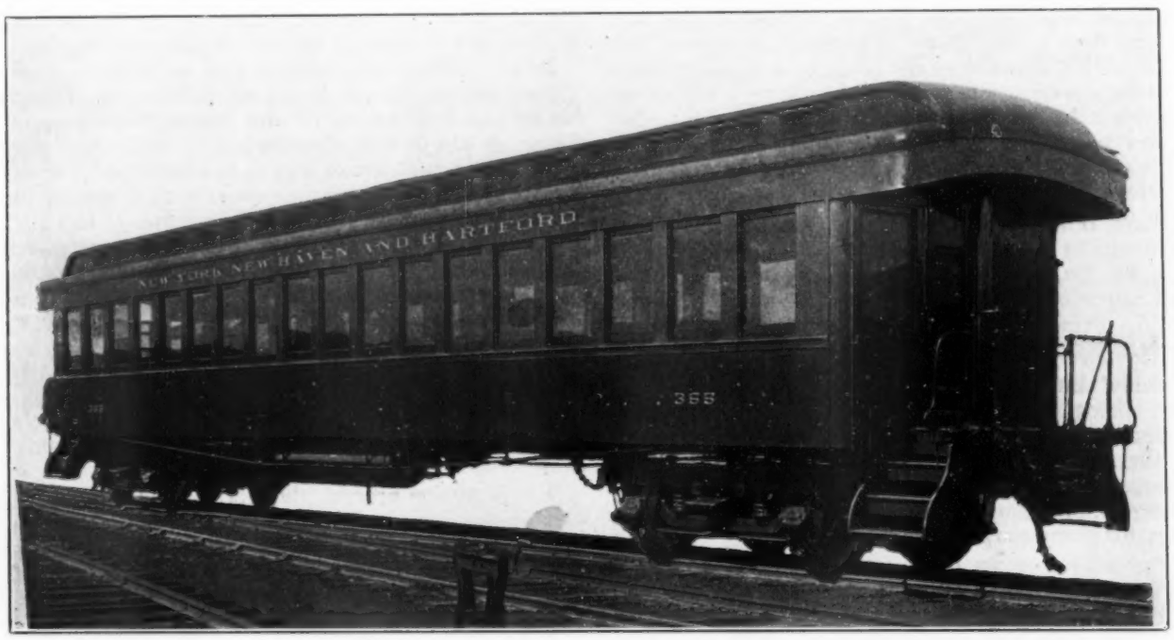


FIG. 1.—FIRST CAR SHEATHED WITH COPPER.

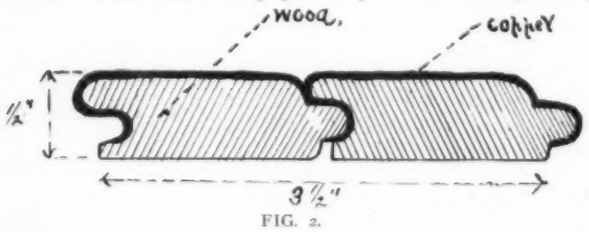


FIG. 2.

The presence of a small amount of tin in antimony is said to render it whiter in color. Some of the English makers of antimony use tinned iron scrap instead of ordinary iron in smelting in order to produce a whiter metal.

THE CRUCIBLE IS NOT DOOMED.

The advent of so many new forms of furnaces for melting copper alloys has, perhaps, resulted in producing a little fear in the minds of the crucible maker in regard to the future of his wares. The new types of furnaces attempt the elimination of the plumbago crucible, an argument which needs no further augmenting for acceptance. The simple fact that there will be no crucible expense is very alluring. In this connection one fact is invariably passed, viz., that of the quality of the metal. For years the manufacture of crucible steel has been attempted in the open-hearth furnace, but to-day more crucibles than ever before are used in the steel industry. To be sure, steel that will take an edge, that will cut, and which is strong, is made in the open-hearth furnace, but we think it may be rightly said that the difference between a good and bad tool may lie in the fact that the steel was either made in a crucible or in the open-hearth furnace.

And so it will be with copper alloys. For certain grades of metal where the highest refinement in the way of maintenance of mixture is unnecessary or in the quality of product the type of furnace which uses no crucibles will have a large field, but where the condition is such that the mixture and waste must be held down, the crucible will always hold its own. We doubt very much whether it is possible to make the finer grades of copper alloys outside of a crucible; in fact, we have never seen it done. Leaving out the question of melting in large masses, there appears to be, at the present price of oil, no distinct advantage in melting cost in the type of furnace which has no crucible on account of the enormous waste. In making common yellow brass from new copper and spelter the best results which we have seen have been a waste of 5 per cent. The waste of this same mixture in a Naugatuck Valley brass mill has been reduced to a figure below 1 per cent. In fact, an average of three months resulted in a waste of only 0.94 per cent. This latter figure was the result of melting with coal and in crucibles. As for fuel consumption, the best results we have ever seen are those obtained in the use of the class of furnaces where a crucible is used but is not removed from the fire, but the whole furnace is tilted in order to pour the contents. This results in a much longer life of the crucible. In this class of furnace using coke for fuel we have seen eight pounds of metal melted with one pound of fuel; a melting ratio which makes the old pound for pound fuel consumption of the orthodox brass foundry appear significant.

We do not desire to go on record as condemning the type of furnace which uses no crucible, for we believe that in certain lines the field is large; but like the advent of the open-hearth furnace in the steel industry, it will not replace but simply augment the use of crucibles.

LUMEN METAL.

This is an alloy which has been on the market for some time, and the Watertown Arsenal has recently tested and analyzed a sample which was submitted to them. The analysis, as given in *Tests of Metals*, published by direction of the Secretary of War, is as follows, viz.:

	PER CENT.
Zinc	82.52
Copper	9.10
Aluminum	7.68
Lead	0.50
Tin	0.15

A cast bar 1.129 inches in diameter was tested for strength and gave the following results, viz.:

Tensile strength, per square inch	20,300 lbs.
Elongation in 4 inches	0.5 per cent.
Reduction in area	Not appreciable

LEADED GERMAN SILVER ROD.

The demand for a leaded brass rod for free turning is very large, but there appears to be only a small amount of leaded German silver rod made in the United States. There seems to be a limited demand for it, however, but the brass manufacturers do not seem to care to enter into its manufacture. German silver itself is refractory enough without rendering it more so by the addition of lead. This is why the manufacture of leaded rods of German silver is not further advanced than it is. Two difficulties exist—fire cracking and brittleness during drawing.

The German brass-makers appear to have gone into the manufacture of leaded German silver rod, and the following analysis as made on a drawn rod 0.513 inches in diameter. It was made by Geitners Argentan-Fabrik, Auerhammer, Germany. The rod cut very easily, and the chips were short and did not clog the tool. It is a fact well established that a smaller amount of lead in German silver is needed to produce free working than in brass. In German silver one per cent. of lead gives results equal to two and a half in brass. The analysis is as follows:

Copper	56.46	per cent.
Zinc	29.98	" "
Nickel	12.29	" "
Lead	1.14	" "
Iron	.33	" "

The fact will be noticed that this is a low-grade German silver. While all grades are quite refractory, the alloys high in nickel give the most trouble. The difficulty in drawing likewise increases with the addition of lead, so that it is not surprising that the makers of leaded German silver rod should keep it low in nickel.

HAND MELTING LADLES.

There are few shops which do not use the hand ladle for some purpose. The melting of babbitt metal, solder, lead, tin or even rosin or similar material all require the hand ladle. In the manufacture of babbitt metal and solder the hand ladle is as necessary as the hammer to the carpenter, while the machinist cannot reline a journal box without the employment of this tool. It answers as the universal crucible for melting small amounts of metal and may be called one of the necessary shop tools. A shop where a hand ladle is not one of the appliances would be quite difficult to find.

Ordinarily the ladle is made of wrought iron with the handle welded on to the bowl, but this sooner or later breaks away, on account of the weak welded joint. Various attempts have been made to obviate this by riveting on the handle, but a rivet is only a makeshift at the best. Of course, the ladle is made nowadays of either gray or malleable iron, but the brittleness of the former and the inability of the latter to withstand the heat for any length of time renders them more or less unsatisfactory. The W. J. Clark Company, of Salem, Ohio, have had on the market for some time a ladle made of sheet steel and of one piece. The ladle is seamless, and as the handle and bowl is made of one piece of sheet there can be no possible loosening. The handles are much longer than the usual wrought-iron ladle; an agreeable feature, as one who has had occasion to use a short-handled ladle may be glad to testify. Two pouring lips are also furnished, so that it may be poured either right or left handed. This ladle certainly commends itself to anyone who desires a serviceable article.

The Annual Convention of the American Institute of Electrical Engineers will be held June 29-July 3, 1903, at Niagara Falls, N. Y.

THE ALLOYS OF ALUMINUM AND MAGNESIUM.

Much has been heard about the alloys of aluminum and magnesium, called by the inventor "magnalium." Our experience with it in the United States has been somewhat limited; almost, perhaps, to the various short trade notices which have appeared from time to time. Whether these alloys bear out the predictions remains to be demonstrated, but certain features render them interesting at least. Heretofore all materials used for hardening aluminum have been much heavier than this element, and consequently the alloys have been heavier than the parent metal. Magnesium itself, however, is lighter than aluminum, and consequently the alloys share this characteristic. Aluminum has a specific gravity of 2.5, while magnesium is only 1.7. The ores of magnesium, too, are widely distributed, so that if this alloy becomes useful a cheapening in the price of magnesium would be probable. The alloy on account of its lightness holds out some promise, and we reprint the following from the *Journal of the Franklin Institute* on the subject:

"Among the aluminum alloys recently placed on the market, two have especially occupied the attention of metallurgists in a prominent way—namely, 'magnalium' and 'meteorit'—two German inventions. A report on the properties of these alloys has recently been published by a German contemporary, from which we take the liberty to quote the following description:

"About ten years ago Dr. Ludwig Mach experimented with alloys for the production of metal mirrors. It was considered indispensable that the composition aimed at should be light, hard, tough and susceptible of polish, and that its gloss should not be easily affected by the air. An equal mixture of magnesium and aluminum proved a very suitable alloy. Following up this discovery Dr. Mach systematically tried all possible proportions of magnesium and aluminum according to their properties and technical adaptability, giving the most approved one the name of magnalium, on the production of which he has obtained patent rights from the Imperial Patent Office at Berlin. Before this various experiments had been made, with a view to the discovery of suitable alloys, but as at that time neither of the two metals could be obtained technically pure, the alloys did not possess the valuable properties which distinguish the new magnalium.

"Aluminum, as well as magnesium, is most difficult to work, inasmuch as the former chokes up the file and is liable to break, while the latter is so tough that neither a file nor the turner's chisel can make any impression. Magnalium, on the other hand, is more suitable than either of its component parts. Alloys containing up to 30 per cent. of magnesium furnish a metal the hardness of which lies about half way between yellow and red brass, and which may be easily worked with any tool; even the weakest screw-threads can be cut with proper keenness. The chips are like those of yellow brass, the faces of the pieces are smooth and bright, and choking never takes place even with the finest files. Magnalium, moreover, is chemically less assailable than either of its components. Aluminum by itself has a very indifferent exterior, while magnesium by itself is greatly affected by the air, and oxidation will gradually extend far into the interior. Magnalium is silvery white, remains unaffected by exposure to the air, nor can ammonia or acetic or sulphuric acid harm it in any way. It surpasses aluminum in gloss, tractability, firmness and lightness.

"The combinations of aluminum with copper or with zinc can easily be made, but as these two metals are a great deal heavier than aluminum, all the advantages due to the light weight of the latter are lost. While aluminium has a specific weight of 2.7, the alloys referred to range between 3 and 3.5. A notable contrast to this is presented by the specific weight of magnalium, which is less than that of pure aluminum—namely, 2 to 2.5—according to composition. Magnalium produced in Sweden shows a specific gravity of only 2.4 to 2.7.

"Magnalium is sold in the form of bars, tubes, sheets and wire. For melting purposes, crucibles of graphite or of iron are used, the inside of the latter having been lined with clay and magnesia. Molten magnalium can be poured into the thinnest vessels of a diameter of down to 2 millimeters and of the most intricate forms, and will fill them up thoroughly and faultlessly. It becomes soft at 570 degrees, melts at 600 degrees and becomes fluid at 630 degrees C. On account of its lightness and its silvery white color it is in a high degree suitable for metallic mountings on photographic apparatus, optical instruments and similar articles.

"Unfortunately, sea-water is inimical to magnalium, especially when the latter comes in contact with other metals. This defect renders it, of course, impossible to use the new alloy for ships, as desirable as this might be, on account of its lightness and eminent solidity, especially for men-of-war.

"In cases in which, for technical purposes, great solidity is of paramount importance, as, for instance, in regard to large castings, an alloy of from 3 to 5 per cent. of magnesium is most suitable. An addition of 10 per cent. of magnesium would render magnalium brittle, while 30 per cent. of magnesium would reduce the solidity of the alloy still more. With only 2.4 per cent. of magnesium added, magnalium can be forged at a temperature of 400 degrees C., and will then act in a similar way to copper at red heat. If containing less than 5 per cent. of magnesium, it may be forged in the cold state, and if perchance the hammering has rendered it too hard, it can be made malleable again by heating to a temperature of 500 degrees C. and chilling it thereupon in cold water.

"The price of magnalium is about the same as that of copper, and depends mainly upon the price of magnesium. Whereas, aluminum may be had (in Germany) for 2 marks (48 cents) a kilogram, the price of magnesium is kept up steadily at 20 marks a kilogram. Were it not for the high value of the latter metal, the price of magnalium would be considerably lower than that of copper. It is, however, to be expected that the growing demand will lead to an increased production of magnesium, with the result that also this metal will come down much like aluminum, which, as is well known, has experienced an extraordinary reduction within the last few years. The cheapening of magnesium, however, will be the forerunner of more moderate prices for magnalium.

"It remains to be seen whether magnalium will fulfil all the promises given above. Our report states in a general way that aluminium-magnesium alloys also show when worked the great defects of mechanical mixture, as hard places frequently occur in the work. If the tool comes in contact with such hard places it frequently breaks, or the material breaks away, whereby the work done may be considered as practically lost."

A communication by M. Berthelot in "Comptes Rendus" shows that the Chaldeans and Babylonians were possessed of considerable metallurgical skill. A Babylonian statuette was found to consist of a copper alloy containing 79.5 per cent. of copper, 1.25 per cent. of tin and 0.8 per cent. of iron. A statuette from Chaldea, estimated to be 2,200 years old, was composed of nearly pure copper containing only a slight proportion of iron, whereas another Chaldean statuette, some 400 years older, consisted mainly of an alloy of four parts of copper with one part of lead and a trace of sulphur.

PRINTING DEPARTMENT.

In this department we will prepare articles on the subject of Printing from Metals in reply to any questions asked by our readers. Address THE METAL INDUSTRY, 61 Beekman Street, New York.

THE NEW INDESTRUCTIBLE SHADING AND STIPPLE FILMS.

In times past, when the bulk of lithographic color work was executed with the crayon, stipple tints were not frequent, on account of the great cost of producing the dotted backgrounds or skies, and it was an endless task for an artist to set one little dot next to another, and thus, often at the cost of one or more days, produce a stippled surface of a considerable area which could be crayoned in at one-fourth the expense. Still crayon work was not as easy to print; it did not have the clearness and precision of a solid dot; it would often "fill in" or "walk away;" at the same time the character of texture would not be so unique as the modulation made with the pen.

Many inventive brains among the litho fraternity speculated upon some innovation whereby tints, especially *even* tints, could be produced upon stone, in addition to some handwork, and in that way lessen the labor incident to stippling. Progress in this line, as in most other fields of invention, was slow, and by degrees the real thing gradually developed.

The first slip in this direction was the transferring of a tint to the work on stone (which had been perfected in all other details) of a "stock tint," stippled with great care and made in such a manner as to at least accommodate itself to an average number of demands in stipple backgrounds, or skies. Of course, it can be seen that in transferring such a stock tint from another stone, the practice was open to many serious objections, and when a tint was once transferred but little could be altered thereon, and a stiff, uncompromising effect was the result. In the same manner ruled tints were transferred from one stone to another, and all this was done for the purpose of avoiding the grain in color work and be able to secure an open, cleanly printing texture. The next move in this matter was made by inventing rubber pads, much on the rubber stamp idea, inking up the little raised dots and transferring them by a simple movement of the hand to those places on the stone where they were needed.

This was certainly a move in the right direction, for it opened up the gates for the right thought. The deficiency in these rubber pads was that a person could not see where to press a little more or less so as to produce a certain degree of modulation, i. e., by pressing a little more upon the back of the rubber, set off a little more ink at that place. At this point, what was more natural than for an inventive genius to seize upon the idea of making those pads of a *transparent material,* and then, having inked up the protruding dots, lay the film over the work and press gently in some places and harder in others; at least try to get some kind of a modulation of tone. This bright thought was left for Mr. Benjamin Day, a former crayon artist, to develop, and he did seize it in royal style. He perfected the invention as far as setting the film into a frame and adjusting that frame to a micrometer attachment upon a long metal bar, solving the problem thereby of thickening the dots of lines and be able to take off the frame and readjusting it after re-inking it and setting it back in its place, so that line upon line and dot upon dot would fit precisely in the same place as it was before. This simple little device enables the operator, by turning a micrometer screw, to thicken up a set of lines or dots at will, so that, although the line or stipple film itself has a perfectly even layer of lines, yet the work on stone can be so handled that the most powerful gradation from light to dark can be obtained. Likewise, the crossing of a tint can be attained, and there being about fifteen different patterns, from fine half-tone imitations to very coarse pen strokes and dots, lines and grains, it is evident that all character of work can be executed and all values matched.

A new film has recently been put on the market by an European chemist, who uses other substances—a sort of gut or animal tissue which is not hygroscopic, not liable to harden, always remains taut, yet never gets strained, and always remains soft and pliable and clear as glass. These are the Grube films, and can be bought from an American agent, together with a unique arrangement for setting the films horizontally or perpendicularily, latterally or longitudinally. They are now not only used on stone in producing stipple color plates, but also on zinc or cardboard for backgrounds, shades on lettering in photo line work on metal, for direct decoration as well as for check and draft backgrounds. The multiplicity of patterns one is liable to produce without the exercise of skill or effort is unlimited, and, furthermore, the work is clean, clear, crisp, and is accomplished in one-tenth the time taken by the old method.

The modus operandi for using these films is the following: If a tint, say a stipple or a straight line, is desired upon a stone, the high or positive lights are there stopped out with thin gum arabic; then the film is inked up with a special ink by a gum roller, and the film is then set between the pivots of the holding attachment and with the bar raised to the level of stone, so that the film will lay flat; then a stump or agate point (in flat tints, a roller) is pressed upon the back. The film being perfectly transparent, the line or stipple work can be deposited to any place wanted, and the stone is then ready for etching. On metal the gumming is done with gamboge, but otherwise the same method as on stone, only it is safe to dust the freshly lined plate with resin powder before giving it to the etcher. On cardboard the shades on lettering are done by cutting out a frisket from thin transparent paper, having all places open where tint is wanted, and of course selecting a coarser or wider line, so as to allow for reduction.

The Government of Mexico has granted to Messrs. H. H. Moran and J. Emilio Meyer the right to work and quarry lithographic stone on land belonging to the Government. The sum of $100,000 is to be invested in the enterprise and the plant is to be open to the scholars of the national schools.

Aluminum has been found to be one of the necessary adjuncts in galvanizing. A very small percentage renders the spelter cleaner and capable of spreading over a large amount of surface. The coating is more uniform than that produced without aluminum and the lustre much brighter. The latter is so satisfactory that some manufacturers are calling the coating "Silver Finish."

THE METAL WORKERS CLUB.

The Association of Manufacturers of Brass Goods for Steam, Water and Gas has been dissolved and a new organization called the Metal Workers' Club has been formed to take the place of the Association. William M. Webster, of Chicago, Ill., is Commissioner of the Metal Club. Mr. Webster has recently issued a circular letter setting forth the purposes of the new organization and giving a list of the manufacturers of plumbers' brass work, most of whom are members or are working with the prices and rulings of the Metal Workers' Club.

THE PRODUCTION OF POLISHED NICKEL PLATE IN THE PLATING BATH

Nickel plate as it comes from the bath is ordinarily more or less rough and requires buffing in order to give a satisfactory surface. For years the production of a bright silver plate has been produced without the necessity of polishing by means of the introduction of bisulphide of carbon into the bath. The work comes from the bath in a bright, polished condition which, for cheap work, is quite satisfactory. Salts of a similar nature do not appear to have the same influence on the nickel bath; in fact, they act in an adverse way and produce a rougher coating than is formed without them. J. G. Zimmerman has made some experiments in the laboratory of the University of Wisconsin on the employment of rotating cath-

PRODUCTION OF POLISHED NICKEL PLATE.

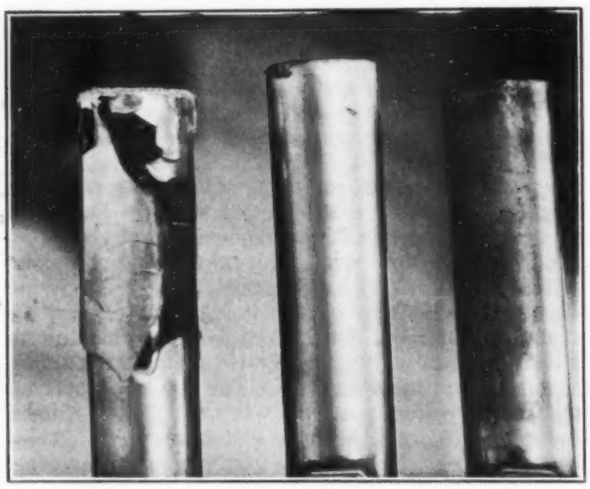


FIG. 1. FIG. 2. FIG. 3.

odes and finds that in nickel plating the deposit may be obtained in a polished condition if the cathode (the work) be rotated with great velocity. This fact, however, has been noted by Cowper-Coles, of London, in the case of copper, who found that a high polish is given electro-deposited metal if the cathode have a peripheral velocity of 1,000 feet per minute. Not only can a polished surface be produced, but a much thicker deposit may be obtained.

In the case of nickel the usual current density employed is about 6 amperes per square foot. By rotating the cathode at a velocity of 1,000 revolutions per minute, Mr. Zimmerman found that a current density as high as 300 amperes per sq. foot may be used and obtain a good deposit. If, however, the cathode is not rotated the deposit is not coherent, but is deposited in a powdery or spongy condition. For the solution the ordinary double sulphate of nickel and ammonia was used and at first it was thought that the bright deposit was caused by the solution becoming somewhat acid, but the addition of a small amount of sulphuric acid to the bath entirely ruined the deposit, so that just what factors this bright deposit depends on is not understood, but the fact that the cathode must be rapidly rotated is certain. The deposit of the nickel which is obtained by a rotating cathode may be made much thicker thereby, without the liability of the deposit cracking and peeling off, as is the case when a thick deposit is attempted by plating in the ordinary manner with the cathode remaining stationary.

In the experiments conducted by Mr. Zimmerman a brass tube 7/8 in. diam. was used for the cathode and this formed a good material to rotate. In Fig. 1 is shown the effect of adding the acid to the bath; the deposit peeled off. In Fig. 2 the effect of making the bath alkaline with ammonia is shown. This is the usual condition obtained in ordinary nickel plating where it is customary to add a slight amount of ammonia if the bath becomes acid. The deposit in this case is dull white. In Fig. 3 is shown the effect of starting with a neutral solution and rapidly rotating the tube, the deposit in this case being highly polished and coherent. In all three cases the current density was the same and the tube rapidly rotated.

From Mr. Zimmerman's experiments, therefore, it appears that in order to obtain a polished nickel plate in the bath the following conditions are necessary, viz.:

1. The cathode (article to be plated) must revolve at a high speed. A velocity of 2,500 revolutions gives good results.
2. The current density must be high. One of 300 amperes per square foot has been found to be satisfactory.
3. The solution of double sulphate of nickel and ammonia should be neutral when commencing.
4. The bath should be concentrated and cold.

A UNIQUE APPLICATION OF ELECTRO-PLATING.

The firm of F. A. Ringler & Co., of 26 Park Place, New York City, well known as designers, engravers and electrotypers, have applied the electro-plating process to the preservation of relics, keepsakes and trinkets of a perishable nature. They have recently applied it to the preservation of the shoes of childhood days, the first to be worn

BABIES' SHOES.

by the baby of the house. After a chemical preparation of the leather shoes to allow an electro deposit then copper, oxidized silver, antique brass or old gold may be plated over them. Of course, every impression of the feet, the ripped seams, the stubbed toes and torn leather are kept perfectly intact. Although a revival of some of the early methods in the electro-plating line, the adaptation in this particular direction is very unique and commendable.

That a firm and coherent deposit cannot be obtained by plating one metal on to a base of a similar metal is a fact not generally appreciated. For instance, silver, if plated on to an article which has been silver plated before, does not adhere as well as that which is deposited on to a different metal. In order to render the plating of old work satisfactory it is necessary to remove the first plating by means of the so-called "stripping" solution, a solution which is so made that only the plating is attacked.

Fluor-spar is used to considerable extent in the brass and copper business as well as in the iron industry. It makes a good flux, but unless pure a contamination of the metal is liable to follow. A variety of lead ore (galena) is usually associated with fluor-spar in nature and when mined the two are mixed together. The lead will enter the metal and, in certain lines of work, cause difficulties. The lead may be easily detected by a careful inspection.

CORRESPONDENCE DEPARTMENT

In this department we will answer the inquiries of readers who have shop and foundry problems in the working and casting of aluminum, brass and copper, their allied metals and alloys. Address all communications to THE METAL INDUSTRY, 61 Beekman Street, New York.

Q.—We have been asked the relative merits of the chain draw-bench and the hydraulic bench in the manufacture of tubing.

A.—There are two distinct advantages of the hydraulic bench over the chain bench, although the latter is by far the cheapest to install, both in the bench itself and from the absence of pumps, accumulators, etc. In the chain bench the power is constantly the same. The pull at the starting of the tube through the die is exactly the same as it is in the middle of the operation. The starting of the tube through the die, therefore, is invariably accompanied by a jerk, which often results in a broken end. With the hydraulic bench, the starting may be gradual and rapidly become accelerated, if desired. The chain bench is also apt to impart a wavy appearance to the tube on account of the chain meshing in and out of the driving gear.

Q.—A manufacturer states that he has been attempting to harden copper for a particular electrical purpose, but has not been completely successful. He has seen the statement that vanadium will harden the copper, but wishes more accurate information.

A.—Our experience with the so-called tempered copper products has been that they are nothing more than plain copper castings, often good and sometimes very poor specimens of the founders' art. We fancy nearly everything has been tried for the purpose of hardening copper, but with little success. We have had no experience with vanadium, so cannot say whether it will accomplish the purpose or not. If a sound copper casting is desired, silicon is an excellent material, and for the description of its use we refer you to our January issue.

Q.—A smelter asks for a good flux for melting aluminum skimmings.

A.—We have found that fluxes are of little use in smelting aluminum skimmings, but the following method answers the purpose: In a large crucible, say a No. 200, melt a quantity of aluminum or aluminum alloy. Have the crucible about one-quarter full and the metal at a bright red-heat. Remove the crucible from the fire and stir in the aluminum skimmings. All the metallic aluminum will be dissolved by the metal and the oxide will rise to the top in a fine powder and may be skimmed off. As aluminum skimmings are usually in the form of a mixture of thick metal and oxide, this process serves to dissolve the metallic aluminum. One feature that is necessary for the success is the keeping of the metal at a bright red heat. If this is not done the oxide will not rise to the top, but will mingle with the metal and produce a thick, pasty mass.

Q.—A subscriber wishes to make a good brass dipping solution—one which will not make the work rough, but will give a smooth, bright surface.

A.—The rough surface on dipped brass is caused by the acid being too strong and consequently working too rapidly. The following is a good solution, viz.: Nitric acid (aqua fortis), 1 part; sulphuric acid (oil of vitriol), 2 parts; water, 2 parts. All of these proportions are by measure. Pour the nitric acid into the water and then add the sulphuric acid to this mixture. If the mixture works too slow it may be slightly warmed.

Q.—A jewelry plater wishes to know how to deposit a rose red gold deposit by electro-plating.

A.—A rose red or pink colored gold deposit may be obtained in the following manner: To an ordinary gold bath add just enough cyanide of copper solution to give a red gold deposit. This can only be found by adding the cyanide of copper solution little by little until the required tint is obtained. This red gold color is only put on after a gold plate has been deposited in the regular manner. Over this red gold deposit a very thin pellicle of silver plate is now deposited and after the article has been dried and burnished the pink tint will be present. Of course, this will tarnish on account of the silver present, so that a coat of lacquer is often required.

Q.—A plater desires information about recovering gold from a stripping solution and refining it after it has been recovered.

A.—Evaporate the solution to dryness and fuse the residue with a little dry carbonate of soda in a plumbago crucible. A button of gold will result. The amount of carbonate of soda need not be exact, but should be in excess.

To refine the button melt it with three times its weight of pure silver and boil the resulting button with nitric acid (sp. gr. 1.2). This will dissolve out everything but the gold. The gold left in the form of fine powder is now washed and if it is to be used for dissolving it need not be again melted. If it is necessary to melt it, however, fuse in a plumbago crucible under a flux of equal parts of borax and nitre.

Q.—A manufacturer wishes to have us state the process for electro-tinning and electro-galvanizing.

A.—Tin may be deposited by electro-deposition, but the bath requires constant attention, as the anode is not dissolved in proportion to the amount of tin deposited. The bath, therefore, requires frequent additions of new salts. The bath is composed of water, 5,000 parts; pyrophosphate of soda, 50 parts; chloride of tin (crystals), 6 parts. The article to receive the tinning should have a roughened surface, as the tin then adheres better. The anode should be of pure tin and a strong current is necessary.

The bath used for electro-galvanizing is a neutral sulphate of zinc solution containing 50 oz. of sulphate to 1 gallon of water. A lead anode may be used as the zinc is taken from the solution and not the anode. The solution must be constantly replenished. A strong current must be used, otherwise a powdery deposit is formed. A current density of 30 amperes per square foot gives good results.

At the annual meeting of the New York Metal Exchange, held March 30, the following officers were elected: President, Robert M. Thompson; vice-president, Adolph Lewisohn; treasurer, Charles S. Trench.

The management of the Louisiana Purchase Exposition, to be held in St. Louis in 1904, are making special efforts to have a representative exhibit of the mining metallurgical interests of the United States. It is stated that the exposition will give an excellent opportunity to extend business locally as well as internationally.

The American Foundrymen's Association will hold their 1903 convention at Milwaukee, Wis., June 9, 10 and 11. The various sections of the Association will have special discussions at the meetings. Besides the sections of chemistry and metallurgy, there is a movement to have departments relating to pattern makers and foundry accountants.

TRADE NEWS

The Leather and Brass Manufacturing Company, of Auburn, N. Y., manufacture a number of specialties, including automobile pumps, pump leathers, leather plunger packings and air compressors.

A specialty of the Rudolph and Summerill Tubing Company, of 302 N. Broad street, Philadelphia, is tubing in any size between one inch and 1-100 and in any of the metals or alloys.

The Ohio Pump and Brass Company, Columbus, Ohio, have, during the past two years, doubled the size of their plant and are expecting soon to still further enlarge it. The company manufacture brass, bronze and aluminum castings and gas and water supplies.

The Columbia Smelting and Refining Works, of New York City, have bought the plant of the Process Copper Company in Jersey City, which was sold at public auction. The Process Copper Company's plant is of considerable size, measuring 50 x 125 feet and has fourteen furnaces. The plant is capable of producing castings of a ton weight. The Columbia Smelting and Refining Works have not announced what use they will make of the property.

The Hudson Rolling Mill Co., of Bloomfield, N. J., having outgrown their present quarters, are now erecting a plant on the line of the Lackawanna Railroad, where they will have direct railroad connections. They will engage in the manufacture of cold rolled copper and brass in addition to the manufacture of britannia metal and music plates, and expect to have their plant in operation about July 1. The officers are: Wm. S. Benson, president; Harry B. Martin, vice-president, and Peter J. Quinn, secretary and treasurer. They also manufacture babbitt metals.

The S. Obermayer Company, manufacturers of foundry facings, supplies and equipments, are making large improvements at their Chicago plant, 18th and Rockwell streets. New machinery and new buildings have just been completed, which add about 40 per cent. to their present capacity at the Chicago plant. During the past year improvements were made at the Cincinnati, O., plant, also the Pittsburg plant, which doubled the capacities at both places. The S. Obermayer Company have now these three plants in full operation, running each plant twenty hours per day, all of them being equipped with modern machinery.

The celebrated Hoyt and Martin Electric Magnetic Separator is a machine particularly well adapted for brass foundry use, as it has no exposed working parts. The magnets are all enclosed in the cylinder, so that they cannot become injured. This is quite an important feature, as a magnet machine receives rough usage in a foundry. Another important feature is that this separator uses no revolving brush to sweep off the refuse, as it is dropped automatically by means of contact devices which control the magnetic cylinder and only that portion of the cylinder which is exposed for separating purposes is magnetized. The Elm City Engineering Co., of New Haven, Conn., who manufacture this machine, report recent sales in Scotland and in Australia.

The plant of the International Tin Company at Bayonne, N. J., which will smelt tin, is expected to be in operation by August.

The Dings Electro-Magnetic Separator Company, of Milwaukee, Wis., make separators of different types, different sizes and of special design.

The Globe Machine and Stamping Company, of Cleveland, O., are putting on the market a new design of oblique tumbling barrels, which are used for cleaning, brightening or polishing sheet metal stampings and brass castings.

On account of increasing business the Ross Crucible Company have moved their works from 1445 North Marshall street, Philadelphia, to Tacony, a suburb of the same city, where they will have a much larger plant.

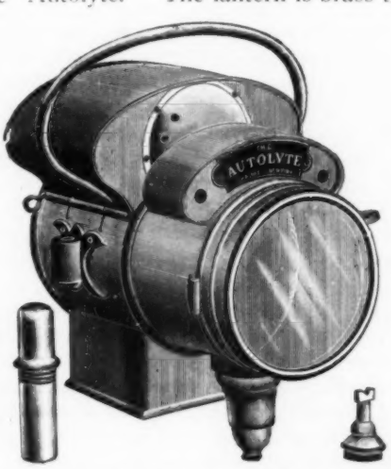
The Atlas Smelting and Refining Company, of Philadelphia, have increased their capital stock to $50,000 and have started a smelting works at Baltimore, Md. Besides spelter, their chief product, the company will manufacture zinc white, chloride of zinc, sulphate of zinc and glaubers salts.

BRASS VALENTINES.

Brass valentines are novelties which have recently been brought out for supplying the demand for an artistic and permanent article. These valentines are brass plates, highly finished, and upon which a suitable inscription is etched or stamped. An ornamental frame surrounds the whole. Although somewhat costly, compared with the usual paper or celluloid article, such a combination of art, fine metal work and sentiment form a gift which is not only ornamental, even in the estimation of the most fastidious, but practically indestructible.

BRASS LANTERN.

The accompanying cut shows a fine specimen of brass work in the shape of an automobile lantern. It is manufactured by A. H. Funke, 325 Broadway, New York, and is called the "Autolyte." The lantern is brass throughout



with the exception of a German silver reflector, and all parts are riveted. It is highly polished and burns both acetylene gas and a candle. The lantern complete sells for $55.

TRADE NEWS

The Langsenkamp Brothers' Brass Works, Indianapolis, Ind., report a healthy trade and no indication of it slackening.

C. L. Berger & Sons, manufacturers of surveying, engineering and astronomical instruments, have moved their office and works to 37 William street, Boston, Mass.

The Le Roy Shot and Lead Works, 261 Water street, New York City, are sending out a printed folder calling attention to the fact that they have manufactured sheet lead and lead pipe for half a century.

J. H. Gautier & Co., of Jersey City, N. J., issue a pocket memorandum book, which contains some interesting information and some facts about the "Gautier" crucibles and other brass foundry products.

The Ostby and Barton Company, of Providence, R. I., are now building a new six-story factory and will install a large amount of new machinery. This company is said to be the largest manufacturers of jewelry rings in the world.

The E. H. H. Smith Silver Company have purchased the factory at Bridgeport, Conn., formerly occupied by the Nottingham Lace Company, and are preparing to manufacture a full line of flat ware in addition to their patent table knife with a steel inserted edge.

The Ajax Metal Co. of Philadelphia, Pa., have just issued an elaborate catalogue of their products. This catalogue not only describes their wares, but also contains an extensive and instructive treatise on the question of bearing metals written by their chemist, Mr. G. H. Clamer. The pages are profusely illustrated and the whole forms one of the best catalogues for compilation and taste that has been brought to our notice.

The New Jersey Aluminum Company, of Newark, N. J., intend to enlarge their factory by putting up a four-story brick building, 50 x 75 feet. This addition will be put up on the Springfield avenue side of the company's lot, giving the building fronting that avenue the same length as the one that fronts 19th street. The New Jersey Company have been doing considerable work in automobile castings and among their new novelties are check punches and display stands for the liquor trade.

Richards & Co., metal dealers, of 60 Union street, Boston, Mass., report that they have remodeled their office and sales department, and besides carrying a general line of sheet and pig metals have added a stock of sheet aluminum and have taken the New England agency for Richards' aluminum solder. Their office and warehouse is situated in the very middle of the business section and has been in this part of the city since the firm was established, 1812. They have occupied their present quarters for a quarter of a century. The remodeling of the office and shipping departments was necessitated by increasing business.

Burglars have been looting laboratories in Virginia and Kentucky recently of all of the platinum apparatus.

Mr. W. F. Pflueger, formerly with the Manitowoc Aluminum Novelty Company, is now Secretary of the Western Toy Company, of Manitowoc, Wis. Mr. Pflueger has found a use for aluminum in the manufacture of toys.

The Manitowoc Aluminum Novelty Company, of Manitowoc, Wis., inform us that their sales this year have increased over those for a corresponding period of 1902 and that their business prospects are good. The company have added recently new machinery and are thinking of putting in a large stamping press.

S. H. Quint & Sons, of Philadelphia, recently made a bronze tablet 24 x 26, which is to be placed on an historic court house. S. H. Quint & Sons make a great variety of goods and their illustrated catalogue No. 26 shows that besides stencils, rubber stamps, seals and checks, the company manufacture metallic pattern letters and name plates. Their checks and name plates are made in all of the non-ferrous metals and alloys.

A daily paper of St. John, N. B., publishes several columns about the Aluminum Reduction Company, of New Brunswick. Application for incorporation has been made for the right to carry on the business of manufacturing alumina, aluminum and aluminum goods of all kinds. The company is capitalized at $6,000,000. The provisional directors for organization are: James Robinson, James Domville and Charles J. Coster, of St. John, N. B.

The Comb Committee of the American Aluminum Association have held a number of meetings within the last three months and the results are reported to be satisfactory as far as they have gone. There seems to be a better feeling among the competing manufacturers, though one manufacturer reports that there is still room for improvement. Interest is already evinced in the next annual meeting of the American Aluminum Association, which is to be held in New York during September.

FOR SALE—Eight coal burning furnaces, almost new. Address W. D., ALLEN MANUFACTURING CO. 151 Lake street, Chicago, Ill.

WANTED—Position by a foreman of wire drawing department in a brass mill.—Address "Foreman," THE METAL INDUSTRY, 61 Beekman street, New York.

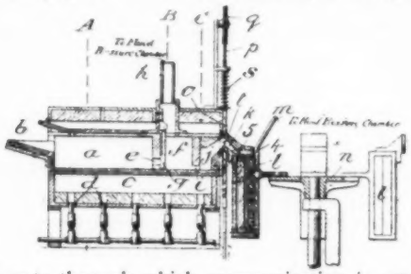
FOR SALE—THREE ROLL SHEET METAL STRAIGHTENER, 4⅞ x 24" Rolls. Made by Farrel Foundry and Machine Company. NEARLY NEW.
HANDY & HARMAN, Bridgeport, Conn.

WANTED.—A position as Factory Manager or charge export department, about June 1, by an American under 40, with manufacturing, jobbing, retail and export experience. Now successfully handling foreign branch with over a million turnover. Wants to return to America. Home references.
EXPORTER, BOX 231, SYDNEY, AUSTRALIA.

PATENTS

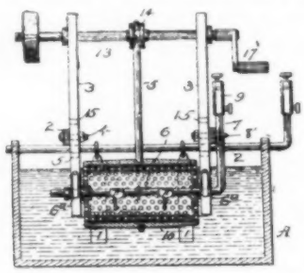
A full copy of any Patent mentioned will be furnished for Ten Cents. Address THE METAL INDUSTRY, 61 Beekman Street, New York

721,381, Feb. 24, 1903. CASTING MACHINE.—William A. McAdams, Brooklyn, N. Y. In combination, a mold, a pressure-



chamber, a gate through which communication is established between the pressure-chamber and mold, means for holding molten metal in position to enter the gate, and means for supplying fluid-pressure to the chamber, the said mold being provided with an air-passage independent of the gate for admitting fluid-pressure to the interior of the mold during the pouring of the metal, substantially as set forth.

721,402, Feb. 24, 1903. ELECTROPLATING APPARATUS.—Joseph Walters, Sumter, S. C. In a cleaning, plating and burnishing ap-



paratus, the combination with a horizontal portable frame constructed to be removably placed upon and temporarily supported by a tank, of depending standards, attached between their ends to said frame, a perforated drum mounted between said standards, a metal rod in said drum and means carried by the standards for rotating the drum.

721,638, Feb. 24, 1903. ART OF PRODUCING AND REFINING METALS, METALLOIDS, AND ALLOYS.—Eugen Straub, Nuremberg, Germany. A process for treating metals, metalloids and alloys which consists in passing the vapor of the metal, metalloid or alloy under treatment through a fused zone of a combination of the said metal, metalloid or alloy with oxygen, and condensing, in the manner and for the purpose substantially as described.

721,814, March 3, 1903. METHOD OF PRODUCING ALLOYS OF ALUMINUM.—Anton Manhardt, Vienna, Austria-Hungary. The herein-described method of producing an alloy of aluminum which consists in first melting tin, antimony, phosphorus, copper and magnesium, then adding molten aluminum, thoroughly stirring the mixture, adding bicarbonate of sodium and sulfur, and finally heating the mixture.

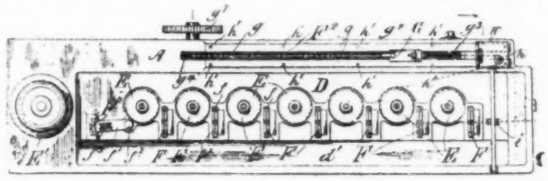
722,148, March 3, 1903. SILVER-PLATING OR GILDING PROCESS.—Josepha Schiele, Brussels, Belgium. A silver-plating or gilding process for iron, steel nickel and other metal without the use of copper consisting in submitting the article to be plated to an electrolytic tinning-bath having an addition of a solution of salts of aluminum and of magnesium in order to cover them with an intermediate deposit composed of mixture of tin, aluminum and of magnesium and then silver-plating and gilding the articles in the ordinary manner.

722,273, March 10, 1903. SOLDER. William D. Baldwin, Washington, D. C., administrator of Harry William Neild, deceased, and Frank Campbell, county of Kent, England. A solder consisting of five per cent. of aluminum, five per cent. of antimony, and ninety per cent. of zinc.

724,108, March 3, 1903. COMPOSITION FOR COATING METAL WITH SILVER.—Edward D. Kendall, New York, N. Y.—The composition of matter consisting of a salt of silver, a suitable thiosulfate and silicious powder, substantially as described.

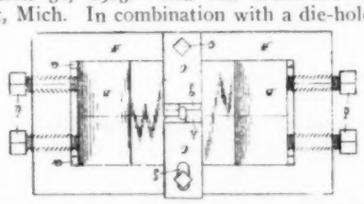
724,107, March 31, 1903. COMPOSITION OF MATTER FOR ELECTROLYTAC DEPOSITION.—Edward D. Kendall, New York, N. Y.—1. The composition of matter consisting of a suitable aurate and a suitable ferrocyanid, substantially as described and for the purpose specified. 2. The herein-described composition of matter for preparing an electrolyte to be used for the electrolytic deposition of gold, consisting of potassium aurate with a small excess of alkali-metal hydroxid and a large excess of potassium ferrocyanid, substantially as described.

725,472, April 4, 1903. WIRE-DRAWING MACHINE.—John H. O'Donnell, Waterbury, Conn. In a wire-drawing machine, the



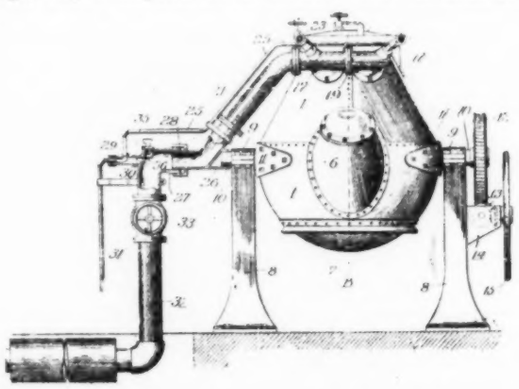
combination of a suitable framework, a tank carried thereby and having an irregular bottom to produce different depths therein, said tank adapted to contain a liquid and a plurality of drawing heads or rolls arranged vertically in the shallower portions of said tank, the deeper portions thereof being adapted to receive and retain the dirt unaffected by the circulation of liquid, due to the rotation of the drawing heads or rolls.

723,873, March 31, 1903. DIE FOR DRAWING WIRE.—James Howe, Detroit, Mich. In combination with a die-holder, the main



dies adjustable from and toward each other and detachably secured within the die-holder, a second die-holder having a set of dies adjustably secured therein in front of the main die at substantially right angles thereto, and means secured to the second die-holder for guiding the article to be drawn through the dies.

725,490, April 14, 1903. FURNACE.—Edward H. Schwartz, Chicago, Ill., assignor to the Hawley Down Draft Furnace Company, Chicago, Ill., a corporation of Illinois. The combination of a



tiltable furnace having a burner arranged to discharge a flame therein, trunnions for the furnace on which it rocks or tilts, a fuel-supply pipe communicating with the burner, a source of fuel-supply, and a block arranged to rock in unison with the furnace and having a longitudinal and a lateral passage communicating with each other, the latter of which passages is in communication with said fuel-supply pipe and the former of which with said source of fuel-supply.

Metal Prices, May 4, 1903

METALS.

	Price per lb.
TIN—Duty Free.	
Straits of Malaca	30.20
COPPER, PIG, BAR AND INGOT AND OLD COPPER—Duty Free. Manufactured 2½c. per lb.	
Lake	15.00
Electrolytic	15.00
Casting	14.38
SPELTER—Duty 1c. per lb.	
Western	5.80
LEAD—Duty Pigs, Bars and Old 2⅛c. per lb.; pipe and sheets 2½c. per lb.	
Pig Lead	4.40
ALUMINUM—Duty Crude, 8c. per lb. Plates, sheets, bars and rods 13c. per lb.	
Small lots	37.00
100 lb. lots	35.00
1,000 lb. lots	34.00
Ton lots	33.00
ANTIMONY—Duty ¾c. per lb.	
Cooksons	8.00
Hallets	7.00
Other	6.63
NICKEL—Duty 6c. per lb.	
Large lots	40 to 50
Small lots	50 to 60
BISMUTH—Duty Free	$1.50 to $2.00
PHOSPHORUS—Duty 18c. per lb.	
Large lots	45
Small lots	65 to 75
	Price per oz.
SILVER—Duty Free—Commercial Bars	$0.55
PLATINUM—Duty Free	19.00
GOLD—Duty Free	20.00
QUICKSILVER—Duty 7c. per lb. Price per Flask	47.00

Sheet Lead, 7¾c. per lb., 20% off.
Lead Pipe, 7⅛c. per lb., 20% off.
Zinc—Duty, Sheet, 2c. per lb., 600 lb. casks, 7.15c. per lb.

PRICE FOR ALUMINUM BRONZE INGOTS.

	Per pound.
2½ per cent	19c.
5 per cent	19½c.
7½ per cent	20½c.
10 per cent	21½c.

Above prices are for lots of not less than 500 pounds.

Manganese Bronze, Ingots	16½c.
Phosphor Bronze, Ingots	15 to 18c.
Silicon-Copper, Ingots	34 to 36c.

OLD METALS.

	Buying.	Selling.
Heavy Cut Copper	12.00c.	13.00c.
Copper Wire	11.00c.	12.50c.
Light Copper	10.75c.	11.50c.
Heavy Mach. Comp	11.00c.	12.00c.
Heavy Brass	8.00c.	9.00c.
Light Brass	6.50c.	7.25c.
No. 1 Yellow Brass Turnings	7.50c.	8.25c.
No. 1 Comp. Turnings	10.00c.	11.25c.
Heavy Lead	4.00c.	4.20c.
Zinc Scrap	4.00c.	4.25c.
Scrap Aluminum, sheet, pure	22.00c.	25.00c.
Scrap Aluminum, cast, alloyed	16.00c.	20.00c.
Old Nickel	15.00c.	25.00c.

PRICES OF SHEET COPPER.

SIZES OF SHEETS.		96oz. & over 75 lb. sheet 30x60 and heavier	64oz. to 96oz. 50 to 75 lb. sheet 30x60	32oz. to 64oz. 25 to 50 lb. sheet 30x60	24oz. to 32oz. 18¾ to 25lb. sheet 30x60	16oz. to 24oz. 12½ to 18¾ lb. sheet 30x60	14oz. and 15oz. 11 to 12½ lb sheet 30x60
		CENTS PER POUND.					
Not wider than 30 ins.	Not longer than 72 ins.	20	21	21	21	21	22
	Longer than 72 ins. Not longer than 96 ins.	20	21	21	21	21	22
	Longer than 96 ins.	20	21	21	21	21	23
Wider than 30 ins. but not wider than 36 ins.	Not longer than 72 ins.	20	21	21	21	21	23
	Longer than 72 ins. Not longer than 96 ins.	20	21	21	21	21	23
	Longer than 96 ins. Not longer than 120 ins.	20	21	21	21	22	24
	Longer than 120 ins	20	21	21	22	23	
Wider than 36 ins. but not wider than 48 ins.	Not longer than 72 ins.	20	21	21	22	23	25
	Longer than 72 ins. Not longer than 96 ins.	20	21	21	22	24	26
	Longer than 96 ins. Not longer than 120 ins.	20	21	21	23	25	29
	Longer than 120 ins.	20	21	22	24	27	
Wider than 48 ins. but not wider than 60 ins.	Not longer than 72 ins.	20	21	21	22	24	27
	Longer than 72 ins. Not longer than 96 ins.	20	21	21	23	25	30
	Longer than 96 ins. Not longer than 120 ins.	0	21	22	24	27	
	Longer than 120 ins	21	22	23	25	29	
Wider than 60 ins. but not wider than 72 ins.	Not longer than 96 ins.	20	21	22	24	29	
	Longer than 96 ins. Not longer than 120 ins.	20	21	23	26	31	
	Longer than 120 ins.	21	22	24	29		
Wider than 72 ins. but not wider than 108 ins.	Not longer than 96 ins.	21	22	24	27		
	Longer than 96 ins. Not longer than 120 ins.	22	23	25	28		
	Longer than 120 ins.	23	24	26	30		
Wider than 108 ins.	Not longer than 132 ins.	24	25	27			
	Longer than 132 ins.	25	26	29			

Rolled Round Copper, ⅜ inch diameter or over, 21 cents per pound. (Cold Drawn, Square and Special Shapes, extra.)

Circles, Segments and Pattern Sheets three (3) cents per pound advance over prices of Sheet Copper required to cut them from.

All Cold or Hard Rolled Copper, 14 ounces per square foot and heavier, one (1) cent per pound over the foregoing prices.

All Cold or Hard Rolled Copper, lighter than 14 ounces per square foot, two (2) cents per pound over the foregoing prices.

Cold Rolled and Annealed Copper, Sheets and Circles, wider than 17 inches, take the same price as Cold or Hard Rolled Copper of corresponding dimensions and thickness

All Polished Copper, 20 inches wide and under, one (1) cent per pound advance over the price for Cold Rolled Copper.

All Polished Copper, over 20 inches wide, two (2) cents per pound advance over the price for Cold Rolled Copper.

Planished Copper, one (1) cent per pound more than Polished Copper.

Cold Rolled Copper prepared suitable for polishing, same prices and extras as Polished Copper.

Tinning Sheets, on one side, 2½c. per square foot.

For tinning both sides, double the above price.

For tinning the edge of sheets, one or both sides, price shall be the same as for tinning all of one side of the specified sheet.

Metal Prices, May 4, 1903

COPPER BOTTOMS, PITS AND FLATS.

Net Cash Prices.

14 oz. to square foot, and heavier, per lb.	25c.
12 oz. and up to 14 oz. to square foot, per lb.	26c.
10 oz. and up to 12 oz.	28c.
Lighter than 10 oz.	31c.

Circles less than 8 in diam., 2c. per lb. additional.
Circles over 13 in. diam., are not classed as Copper Bottoms.
Polished Copper Bottoms and Flats, 1c. per lb. extra.

PRICE LIST FOR ROLL AND SHEET BRASS.

Prices are for 100 lbs. or more of sheet metal in one order. Brown & Sharpe's Gauge the Standard.

Common High Brass	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.
Wider than and including	2 12	12 14	14 16	16 18	18 20	20 22	22 24	24 26	26 28	28 30
To No. 20 inclusive..	.22	.23	.25	.27	.29	.31	.33	.36	.39	.42
Nos. 21, 22, 23 and 24	.22	.24	.26	.28	.30	.32	.34	.37	.40	.43
Nos. 25 and 26.....	.23	.24½	.27	.29	.31	.33	.35	.38	.41	.44
Nos. 27 and 28.....	.23	.25	.28	.30	.32	.34	.36	.39	.42	.45

Add ½ cent per lb. additional for each number thinner than Nos. 28 to 38, inclusive.

Add 7 cents per lb. for sheets cut to particular lengths, not sawed, of proportionate width.

Add for polishing on one side, 40 cents per square foot; on both sides, double this price.

Brazing, Spinning and Spring Brass, 1 cent more than Common High Brass.

Extra Quality Brazing, Spinning and Spring Brass, 2 cents more than Common High Brass.

Low Brass, 4 cents per lb. more than Common High Brass.

Gilding, Rich Gold Medal and Bronze, 7 cents per lb. more than Common High Brass.

Discount from List, 30 per cent.

PRICE LIST FOR BRASS AND COPPER WIRE.

BROWN & SHARPE'S GAUGE THE STANDARD.	Com. High Brass	Low Brass	Gilding Bronze and Copper
All Nos. to No. 10, Inc	$0.23	$0.27	$0.31
Above No. 10 to No. 16..	.23½	.27½	.31½
Nos. 17 and 18	.24	.28	.32
" 19 and 20	.25	.29	.33
No. 21	.26	.30	.34
" 22	.27	.31	.35
" 23	.28	.32	.36
" 24	.30	.34	.38

Discount, Brass Wire, 30 per cent.; Copper Wire, 40 per cent.

PRICES FOR SEAMLESS BRASS TUBING.

From 2 in. to 3¼ in. O. D. Nos. 4 to 12 Stubs Gauge, 19c. per lb. Seamless Copper Tubing, 22c. per lb.

For other sizes see Manufacturer's List.

PRICES FOR SEAMLESS BRASS TUBING Iron Pipe Sizes.

Iron Pipe size	⅛	¼	⅜	½	¾	1	1¼	1½	2	2½	3	3½	4	5	6
Price per lb.	33	29	20	19	18	18	18	18	18	18	18	20	20	22	24	25

BRAZED BRASS TUBING.

Brown & Sharpe's Gauge the Standard.

												Per lb.
Plain	Round	Tube,	¾	in.	up	to	2	in.,	to No.	19,	inc.	$0 35
"	"	"	7/8	"	"		2½	"	"	19,	"	36
"	"	"	1	"	"		2½	"	"	19,	"	38
"	"	"	1⅛	"	"		2⅝	"	"	19,	"	41
"	"	"	1¼	"	"		2¾	"	"	19,	"	48
"	"	"	1⅜	"	"		3	"	"	19,	"	65
"	"	"	1½	"	"		3¼	"	"	19,	"	1 00
"	"	"	1⅝	"	"		3	"	"	19,	"	1 50

Smaller than ⅛ inch.....Special
2 inch to 3 inch, to No. 19, inclusive..... 38
3 inch..... 40
Over 3 inch to 3½ inch..... 45
Over 3½ inch..... 50

Bronze and copper advance 3 cents. Discount 30 per cent.

PRICE LIST FOR SHEET ALUMINUM.

PLATE AND SHEET PRICE LIST.—B. & S. GAUGE.

Prices are for 50 pounds or more at a time. Less quantities, 5 cents per pound additional. Charges made for boxing.

Wider Than.. And Including...	6 in. 14 in.	14 in. 16 in.	16 in. 18 in.	18 in. 20 in.	20 in. 24 in.	24 in. 30 in.	30 in. 36 in.	36 in. 40 in.	40 in. 45 in.	45 in. 50 in.	50 in. 55 in.	55 in. 60 in.	Sat. Fin. with out Lacquer. One Side.	Polishing One Side.
No. 13 & heavier.	42	44	44	44	44	47	47	47	48	48	49	50	6	2
" 14	42	44	44	44	44	47	47	47	48	48	49	50	6	2
" 15	42	44	44	44	44	47	47	47	48	48	49	50	6	2
" 16	42	44	44	44	44	47	47	47	48	48	49	50	6	2
" 17	42	44	44	44	44	47	47	47	48	48	49	50	6	2
" 18	42	44	44	44	44	47	47	47	48	48	49	50	6	2
" 19	44	46	46	46	46	49	48	50	51	51	52	53	6	2
" 20	44	46	46	46	46	49	48	50	51	51	52	53	6	2
" 21	44	46	46	46	46	49	48	50	51	51	52	53	6	2
" 22	44	46	46	46	46	49	48	50	51	51	52	53	6	2
" 23	44	46	46	46	46	49	48	50	51	51	52	53	6	2
" 24	44	46	46	46	46	49	48	50	51	51	52	53	6	2
" 25	44	46	46	46	46	49	48	50	51	51	52	53	6	2
" 26	44	46	46	46	46	49	48	50	51	51	52	53	6	2
" 27	44	46	46	46	46	49	48	50	51	51	52	53	6	2
" 28	44	46	46	46	46	49	48	50	51	51	52	53	6	2
" 29	44	46	46	46	46	49	48	50	51	51	52	53	6	2
" 30	44	46	46	46	46	49	48	50	51	51	52	53	6	2
" 31	44	46	46	46	46	49	48	50	51	51	52	53	6	2
" 32	44	46	46	46	46	49	48	50	51	51	52	53	6	2
" 33	44	46	46	46	46	49	48	50	51	51	52	53	6	2
" 34	44	46	46	46	46	49	48	50	51	51	52	53	6	2
" 35 & 36	44	46	46	46	46	49	48	50	51	51	52	53	6	2
" 37 & 38	44	46	46	46	46	49	48	50	51	51	52	53	6	2
" 39 & 40	44	46	46	46	46	49	48	50	51	51	52	53	6	2
.008" to .0015"	47	49	50	52	54	57	58	60	61	62	63	64	7-8	3
Less than .0015"	60	62	63	66	70	76	82	85	86	87	88	89	9	4

Additional charge for slitting coiled sheet in widths less than 3 in. and flat rolled sheets in widths less than 6 in.
All columns except the first are for Flat Rolled Sheets.

Discounts as follows are given for sheet orders over 200 pounds.

200 to 1,000 pounds	10 per cent. off list.		
1,000 to 2,000 "	10 per cent. and	2	" "
2,000 to 4,000 "	10 " "	3	" "
4,000 pounds and over	10 " "	5	" "

Sheets polished or satin-finished on both sides, double the price for one side.

Price Per Foot of Seamless Aluminum Tubing.

(CHARGES MADE FOR BOXING.)

THICKNESS OF WALL IN STUBS' GAUGE.

Outside Diameter in Inches.	No. 12.	No. 14.	No. 16.	No. 18.	No. 20.	No. 22.	No. 24.	Outside Diameter in Inches.
1-4	.....	.....	.....	10	9	8	7	 1-4
5-16	.....	.....	.....	11	9	8	7	 5-16
3-8	.....	.....	.....	12	9	8	7	 3-8
1-2	.....	.....	17	14	11	9	8	 1-2
5-8	.....	.....	21	16	13	12	.....	 5-8
3-4	.....	.....	25	19	16	14	.....	 3-4
7-8	.....	.....	28	22	18	16	.....	 7-8
1	.....	.....	30	25	21	19	.....	..... 1 00
1 1-4	.....	.....	36	30	25	.....	.....	..... 1 1 4
1 1-2	.....	52	43	35	28	.....	.....	..... 1 1-2
1 3-4	.....	60	50	41	33	.....	.....	..... 1 3 4
2	84	68	58	47	37	.....	.....	..... 2 00

Discount 20 to 30 per cent.

ALUMINUM.

Drawn Rod and Wire Price List.—B. & S. Gauge.

Diameter B. & S. G'ge.	0000 to No. 10	No. 11.	No. 12.	No. 13.	No. 14.	No. 15.	No. 16.	No. 17.	No. 18.	No. 19.	No. 20.	No. 21.	No. 22.
Price per lb	$ 38	38½	38½	0 39	39½	0 40	40½	0 41	0 42	0 43	0 44	0 47	0 52

200 lbs. to 30,000 lbs., three cents off list.
30,000 lbs. and over, four cents off list.

Additional charge for slitting coiled sheet in widths less than 3 in. and flat rolled sheets in widths less than 6 in.
All columns except the first are for Flat Rolled Sheets.